

REMARKS

The Office Action of April 19, 2007 has been reviewed and the Examiner's comments carefully considered. Independent claims 1, 20 and 27 have been amended so as to include the limitations previously set forth in claims 5, 8 and 18. Additionally, claim 23 has been amended to more clearly define the nature of the microwave pulses claimed therein. Claims 5, 7, 8, 18, 21 and 24 have been cancelled. Claims 6, 9, 10, 22, 25 and 26 have been amended to reflect these changes. No new matter is added by this Amendment. Accordingly, claims 1-4, 6, 9-17, 19-20, 22-23 and 25-27 are currently pending in this application.

In the Office Action, rejections of the claims have been made under both 35 U.S.C. § 102(b) and 35 U.S.C. § 103(a). With respect to the rejections under 35 U.S.C. § 102(b), claims 1, 2, 11, 20 and 27 are rejected as being anticipated by Canadian Application No. 2,277,383 to Ridler (hereinafter "Ridler"), claims 1-3, 5, 6, 11, 12, 16, 18, 20-22 and 27 are rejected as being anticipated by PCT Publication No. WO 92/018249 to Beeby (hereinafter "Beeby"), and claims 1, 2, 19 and 20 are rejected as being anticipated by U.S. Patent No. 3,261,959 to Connell et al. (hereinafter "Connell"). Each of these rejections is respectfully traversed.

With respect to rejections under 35 U.S.C. § 103(a), claims 4 and 12-15 are rejected as being unpatentable over Ridler or Beeby or Connell in view of the article *Microwave Energy for Mineral Treatment Process – A Brief Review* by Kazi Haque (hereinafter "Haque"), claims 6, 21 and 22 are rejected as being unpatentable over Ridler or Connell in view of U.S. Patent Publication No. 2003/0029944 to Flinn et al. (hereinafter "Flinn"), claims 6, 21, and 22 are rejected as being unpatentable over Ridler or Connell in view of the article *Short-Pulse Microwave Treatment of Disseminated Sulfide Ores* by Salsman et al. (hereinafter "Salsman"), claims 7, 8, 23 and 24 are rejected as being unpatentable over Beeby, claims 7-10 and 22-26 are rejected as being unpatentable over Ridler or Connell in view of Flinn or Salsman and further in view of U.S. Patent No. 4,313,573 to Goldberger et al. (hereinafter "Goldberger"), claims 12-13 are rejected as being unpatentable over Ridler or Beeby or Connell in view of U.S. Patent No. 4,324,582 to Kruesi et al. (hereinafter "Kruesi"), claims 12-14 are

rejected as being unpatentable over Ridler or Beeby or Connell in view of U.S. Patent No. 6,592,644 to Beckmann (hereinafter "Beckmann"), claim 17 is rejected as being unpatentable over Ridler or Beeby or Connell in view of Great Britain Publication No. 2,198,242 to De Beers Industrial Diamond Division (hereinafter "De Beers"), and claim 19 is rejected as being unpatentable over Ridler or Beeby in view of Connell or Haque. Each of these rejections is also respectfully traversed.

The present invention is directed to methods of treating ore particles so that they can subsequently undergo processing to recover valuable components therefrom. The methods generally include the step of exposing ore particles with a major dimension of 15 cm or less to pulses of microwave energy, with each pulse being less than 1 second in duration. Exposure of the ore to the pulses causes structural alteration of the particles as a result of thermal expansion of the minerals within the ore resulting in micro-cracking or other physical changes within the ore particles. In one embodiment, the treated ore is then processed to recover valuable metals therefrom.

Rejections under 35 U.S.C. § 102

Ridler Rejections

Claims 1, 2, 11, 20 and 27 stand rejected under 35 U.S.C. § 102(b) as being anticipated by Ridler. The Ridler patent discloses a method to enhance the extraction of an element from an ore by subjecting the ore to a thermal shock through administration of microwave energy.

A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference. *Verdegaal Bros. v. Union Oil Co. of California*, 814 F.2d 628, 631, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987). The Ridler patent does not teach every element of the claims, as currently amended, and therefore, does not anticipate the present invention. In particular, the Ridler patent does not teach exposing an ore to pulses of microwave energy, as now set forth in independent claims 1, 20 and 27 of the present application. These claims recite a method where the ore particles are exposed to pulses

of microwave energy, with each pulse being less than 1 second. There is nothing in the teachings of Ridler that discloses or suggests exposing the ore to a pulsed energy source. Instead, Ridler teaches exposure of the ore to a single, continuous beam of energy. (Ridler, pg. 2, lines 13-14). Additionally, the Ridler patent does not teach or suggest limiting exposure to only those ore particles with a major dimension of 15 cm or less, but only suggests that the ore particles should be of a uniform size. (Ridler, pg. 2, lines 2-3).

Because Ridler does not teach a method where ore particles having a major dimension of 15 cm or less are exposed to pulses of microwave energy, Ridler does not anticipate claims 1, 2, 11, 20 and 27. Reconsideration of the rejection of claims 1, 2, 11, 20 and 27 is therefore respectfully requested.

Beeby Rejections

Claims 1-3, 5, 6, 11, 12, 16, 18, 20-22 and 27 stand rejected under 35 U.S.C. § 102(b) as being anticipated by Beeby. Claims 5, 18, and 21 have since been cancelled. Beeby is directed to a method of recovering valuable materials from crushed ore by exposing the ore to pulses of microwave energy of duration between 1 and 30 seconds.

The Beeby reference does not teach every element of the claims, as currently amended, and therefore, does not anticipate the present invention. In particular, Beeby does not teach exposing an ore to pulses of microwave energy that are less than 1 second in duration, as now set forth in independent claims 1, 20 and 27 of the present application. While Beeby does disclose exposing ore to pulses of microwave energy, the pulses in Beeby are, at a minimum, 1 second in duration, and may be up to 30 seconds in duration. (Beeby, pg. 2, lines 3-7). To the contrary, Applicants, in independent claims 1, 20 and 27, have limited exposure of the ore to the pulsed microwave to a duration of less than one second. Consequently, Beeby cannot be said to contain each limitation in the claims and, thus, reconsideration of these rejections is respectfully requested.

Connell Rejections

Claims 1, 2, 19 and 20 stand rejected as being anticipated by Connell. Connell is directed to an apparatus for treating ores by exposing the ore to a high energy microwave field resulting in the chemical decomposition of one or more compounds within the ore.

Connell does not teach every element of claims 1, 2, 19 and 20 as currently presented. Applicants have claimed a method of treating ore particles including the step of exposing the ore particles to a pulsed microwave energy field where the pulses are less than 1 second in duration. Connell, on the other hand, does not teach or suggest these operating limitations. Notably, Connell does not disclose, teach or suggest exposing ores to a pulsed energy field or that the pulses of energy should be less than 1 second in duration. Consequently, Connell does not teach each limitation of these claims and reconsideration of the rejections of claims 1, 2, 19 and 20 is respectfully requested.

Rejections under 35 U.S.C. § 103(a)

In the instant application, Applicants have discovered that utilizing a pulsed microwave beam and limiting the duration of the pulses to below 1 second provides unexpected advantages over the prior art methods of treating ores with microwave energy. By using pulsed energy and limiting the duration of the pulse to less than 1 second, the energy required is minimized and the thermal cycling of the ore particles is maximized leading to better recovery of valuable components from the ore while limiting operational costs. In addition, Applicants have discovered that limiting the size of the ore particles so that they have a major dimension of 15 cm or less ensures that the microwaves are able to sufficiently penetrate the ore to initiate the desired micro-cracking.

Despite the existence of other methods which treat ore with microwave energy, as outlined, for example, in the Ridler, Beeby and Connell references, no one had yet developed or suggested the method now claimed by Applicants in which ore with a major dimension of 15 cm or less is subjected to a pulsed microwave energy field and the pulses are of a duration of less than 1 second. This is an important distinction over previous methods of treating ore particles

since, as mentioned above, it overcomes many of the problems in the field, such as the high energy costs associated with the continuous application of microwaves and the structural degradation that comes from over-exposing the ore to the microwaves. In addition, none of the references cited in combination with Ridler, Beeby and Connell to create the above-mentioned rejections under 35 U.S.C. § 103(a) would render obvious to one skilled in the art the method now claimed by Applicants. The methods described and suggested in the art either result in high energy costs due to a continuous as opposed to pulsed energy source, or result in ore particles that have undergone significant unwanted changes in the mineral composition caused by excessive exposure to the microwave energy.

Haque Rejections

Claims 4 and 12-15 stand rejected as being unpatentable over Ridler, Beeby or Connell in view of Haque. Haque is cited in the Office Action for the proposition that particle size is an important factor in heating ores. However, Haque does not cure the deficiencies in Ridler, Beeby and Connell discussed above. Notably, nowhere in Haque is it discussed that applying a pulsed microwave field to the ores is desirable or even feasible. Haque also fails to mention applying an energy source in increments of less than 1 second. In fact, the example data disclosed by Haque in Tables 7-9 is based on the constant exposure of the ore sample to the microwave energy source for, generally speaking, at least 1 minute.¹ (Haque, pg. 10-12). Haque does not disclose, suggest or even mention a method where the ore is subjected to a pulsed energy field. Consequently, one skilled in the art reading Haque would not be motivated to modify Ridler so that pulsed energy is used or shorten the pulse time of Beeby to less than 1 second. Thus, Haque, whether alone or in combination with Ridler, Beeby or Connell, fails to render obvious the method claimed by Applicants where the ore is subjected to pulses of microwave energy with each pulse being less than 1 second.

¹ While some of the examples performed by Haque did include an energy exposure time of less than 1 minute, the length of the exposure was shortened due to the arcing or melting of the sample or because the maximum temperature was reached.

Flinn Rejections

Claims 6, 21, and 22 stand rejected as being unpatentable over Ridler or Connell in view of Flinn. Claim 21 has since been cancelled. Flinn is directed to a method and apparatus to aid in the recovery of desired materials from ore by exposing the materials to microwave energy sufficient to convert the material to a plasma, which can then be extracted during subsequent processing. Unlike the process in Flinn, the methods now claimed by Applicants do not result in a significant alteration of the mineralogy of the ore. Flinn, on the other hand, provides for the addition of energy sufficient to convert the desired recoverable material to a plasma. Such a conversion would be a significant alteration of the mineralogy. One skilled in the art reading Flinn would not be motivated to follow the teachings therein in an effort to create a method, like Applicants', where the mineralogy of the ore is not significantly affected by the energy exposure. Instead, Flinn would be understood as a method of extracting materials from ore by causing a change to the mineralogy of the ore. Consequently, Flinn cannot be said to have rendered obvious the methods claimed in claims 6 and 22 where high energy, pulsed microwaves are used to treat ore without significantly altering the mineralogy of the ore.

Salsman Rejections

Claims 6, 21 and 22 stand rejected as being unpatentable over Ridler or Connell in view of Salsman. Claim 21 has since been cancelled. Salsman is a study directed to the feasibility of using short-pulse microwave energy as a pretreatment step in comminution. The study in Salsman is primarily directed to the treatment of fine ore particles (Salsman, pg. 47). The size of the fine particles subjected to the short-pulse microwaves and discussed in Salsman is generally between 50 and 600 micrometers (Salsman, pg. 52). Applicants, on the other hand, have made the unexpected discovery that pulsed microwave energy is effective to treat ore particles with a major dimension of up to and including 15 cm. One skilled in the art reading Salsman would not find it obvious that short-pulse microwaves are effective in treating ore particles of that size. Instead, Salsman seems to suggest that short-pulse microwave pretreatment is limited to the processing of fine mineral particles exclusively. The disclosure of Beeby, also directed to the use of

pulsed energy to treat ore, further supports the idea that, prior to Applicants' discovery, pulsed microwave treatment was limited to small ore particles. In each of the examples given in Beeby, the size of the ore particles exposed to pulses of microwave energy is no greater than 16 mm and is generally around 10 mm. (Beeby, pg. 5-6 and 12-14). Consequently, one skilled in the art would not find it obvious that pulsed microwave energy could be used to treat ore particles with a major dimension of up to 15 cm.

Beeby Rejections

Claims 7, 8, 23 and 24 stand rejected as being unpatentable over Beeby. Claims 7, 8 and 24 have since been cancelled. Beeby, as discussed above, is directed to a method of recovering valuable materials from crushed ore by exposing the ore to pulses of microwave energy of a duration between 1 and 30 seconds. Claim 23, which depends from claim 20, includes the limitation that the pulse be less than 1 second in duration. This is not an overlapping range with Beeby since Beeby only discloses a pulse duration of 1 second or greater. In addition, Beeby suggests that the preferred duration of the pulse should be at least 2 seconds and may be as high as 15 seconds. Prior to Applicants' discovery, one skilled in the art reading Beeby would not have appreciated that a microwave pulse duration of less than 1 second would be effective in processing ore. Instead, Beeby seems to suggest that higher pulse duration times are optimal to ensure that the ore is adequately processed prior to the subsequent leaching stage.

Goldberger Rejections

Claims 7-10 and 22-26 stand rejected as being unpatentable over Ridler or Connell in view of Flinn and further in view of Goldberger. In addition, claims 7-10 and 22-26 stand rejected over Ridler or Connell in view of Salsman and further in view of Goldberger. Goldberger is directed to a two-step method for separating minerals where the first step involves subjecting the rock to an electrical current and the second step, which causes comminution of the rock, employs non-impact means such as microwaves. The primary purpose of the process in Goldberger is the ultimate comminution of the rock sample, not the recovery of valuable minerals from inside the ore. The only mention of microwave energy in Goldberger is in relation to the second stage of the process, after the ore sample has already experienced micro-cracking

from the use of an electrical current. One skilled in the art reading Goldberger would not have been motivated to use short pulses of microwave energy to initiate the micro-cracking of an ore sample since Goldberger only mentions the use of microwaves as a means of reducing ore that has already undergone micro-cracking.

Further, even if one were motivated to use pulsed microwave energy to initiate the micro-cracking, there is no indication that the durational limits disclosed in Goldberger, notably the 10^{-3} to 10^{-7} second pulse range, would be applicable to the initial micro-cracking stage using microwave energy. The disclosure of this range in Goldberger is in relation to the first step of the comminution process, namely the application of an electric field to the ore sample. There is presumably a significant difference between the shock waves formed within the ore when the ore is subjected to an electrical discharge between two electrodes directly through the ore and the shock waves formed within the ore from exposure to microwave energy. Thus, it is in no way obvious that the same pulse durations will effectively cause micro-cracking when the ore is instead subjected to microwave energy or even that the pulse duration would be a result-effective variable when applied to such a dissimilar energy source.

Kruesi Rejections

Claims 12-13 stand rejected as being unpatentable over Ridler or Beeby or Connell in view of Kruesi. Kruesi is directed to a process of recovering copper from ore by heating the ore with microwave energy sufficient to convert the copper compound to other compounds. Kruesi does not cure the deficiencies previously mentioned with respect to Ridler, Beeby and Connell. Instead Kruesi is cited merely for the proposition that one skilled in the art would find it obvious to apply Applicants' method to ores which contain copper or which contain valuable metal sulphides. Because Kruesi does not cure the previously discussed deficiencies with respect to currently amended claim 1, which claims 12 and 13 depend from, Applicants respectfully request reconsideration of these rejections as well.

Beckmann Rejections

Claims 12-14 stand rejected as being unpatentable over Ridler, Beeby or Connell in view of Beckmann. Beckmann is directed to a method of extracting metals from copper sulphide or copper iron sulphide ores with leaching. Beckmann does not disclose or suggest, whether alone or in combination with Ridler, Beeby or Connell, treating the ores with pulsed microwave energy or that such pulses should be of a duration of less than 1 second as currently claimed by Applicants in claim 1. Because claims 12-14 are dependent upon claim 1 and include all of the limitations therein, Applicants respectfully request reconsideration of these rejections.

De Beers Rejections

Claim 17 stands rejected as being unpatentable over Ridler or Beeby or Connell in view of De Beers. De Beers is directed to an apparatus that exposes the particles to microwave radiation and then sorts the particles based on the signals generated by the exposure. De Beers is not concerned with the subsequent recovery of valuable components from the ore by initiating micro-cracking and other physical changes within the ore particles. De Beers does not even suggest that the microwave exposure could or should create micro-cracking within the ore. Furthermore, De Beers does not disclose, suggest or make obvious a method where the ore particles are subject to pulses of microwave energy. In fact, the process described in De Beers would most likely require a single, continuous beam of energy since the exposure of a particle to multiple, pulsed energy beams could cause inconsistent detector readings and greatly inhibit the ability of the apparatus to correctly sort the particles. Consequently, De Beers does not cure any of the previously mentioned deficiencies with respect to Ridler, Beeby and Connell in connection with independent claims 1, 20 and 27 of the present application.

With respect to claim 17, De Beers is cited in the Office Action as motivating one skilled in the art to apply the methods of Ridler, Beeby or Connell to diamond-bearing ore. However, while De Beers is ultimately concerned with the recovery of diamond-bearing ore, it does not disclose or suggest that such ore will be subject to micro-cracking when exposed to microwave energy. Without the suggestion or other evidence that these ores will exhibit micro-cracking or other physical changes when exposed to microwave energy, it cannot be said that one

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skilled in the art would find it obvious to apply the method of Ridler, Beeby or Connell to a diamond-bearing ore for the purpose of recovering the valuable components therein.

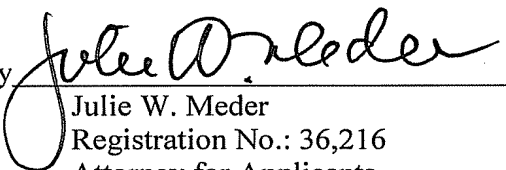
CONCLUSION

For all of the foregoing reasons, Applicants submit that pending claims 1-4, 6, 9-17, 19-20, 22-23, and 25-27 are patentable over the cited documents and are in condition for allowance. Accordingly, reconsideration of the rejections and allowance of pending claims 1-4, 6, 9-17, 19-20, 22-23 and 25-27 are respectfully requested.

Should the Examiner have any questions regarding any of the foregoing, or wish to discuss this application in further detail to advance prosecution, the Examiner is invited to contact Applicants' undersigned representative at the telephone number provided below.

Respectfully submitted,

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